REMARKS

The Final Office Action mailed December 20, 2000, has been received and reviewed. Claims 1 through 47 are currently pending in the application. Claims 1 through 47 stand rejected. Applicant respectfully requests reconsideration of the application as proposed herein.

35 U.S.C. § 112 Claim Rejections

Claims 1 through 47 stand rejected under 35 U.S.C. § 112, first paragraph, as containing subject matter which was not described in the specification in such a way as to enable one skilled in the art to which it pertains, or with which it is most nearly connected, to make and/or use the invention. Applicant incorporates its previous arguments filed in response to this ongoing rejection, and respectfully traverses this rejection as hereinafter set forth.

The enablement rejection posed in the Official Action is inapplicable to the claims of the present invention. The present invention claims processes for depositing tungsten silicide on a substrate, not the tungsten silicide itself. The rejection focuses on the allegation that one having ordinary skill in the art would necessarily have to perform tremendous undue experimentations to form a tungsten silicide claimed as broadly as that recited in claims 1 through 47. This is simply not true. The claimed subject matter is a process of forming tungsten silicide, not a specific type or formation of tungsten silicide. The claimed process is enabled by the claim language and the disclosures contained in the Specification.

"The test of enablement is whether one reasonably skilled in the art could make or use the invention from the disclosures in the patent coupled with information known in the art without undue experimentation." *U.S. v. Telectronics Inc.*, 8 U.S.P.Q.2d 1217, 1223 (Fed. Cir. 1988) (*citing Hybritech Inc. v. Monoclonal Antibodies, Inc.*, 802 F.2d 1367, 1384, 231 U.S.P.Q. 81, 94 (Fed. Cir. 1986), *cert. denied* 107 S.Ct. 1606 (1987)) (emphasis added); *see also MPEP* § 2164.01. Applicant has satisfied this test.

The disclosure enables the rejected claims. Generally, claims 1 through 47 claim a

process for depositing a tungsten silicide film on a substrate. The processes claimed are enabled by the Specification. For example, the Specification describes at least one preferred embodiment of a process for depositing a tungsten silicide film on a substrate:

> By way of example and not limitation, at a temperature of about 450°C. and with a silane flow rate of about 400 sccm, this nucleation layer is deposited in about 1-25 seconds. This requires a flow of reactant gas (WF_6) of about 4 sccm and a flow of inert gases (Ar, N_2, He) of about 2800 sccm. Following deposition of the nucleation layer the silicon source gas may be switched abruptly or gradually to dichlorosilane and the tungsten silicide film can be deposited to the desired thickness using the dichlorosilane as the source gas. *Specification*, col. 3, line 62 through col. 4, line 3.

Following this example, one of ordinary skill in the art would be able to deposit a tungsten silicide film on a substrate using one of the claimed processes. The stoichiometry of the formed tungsten silicide film is irrelevant, because it is the process that is claimed, not the tungsten silicide film.

Even if one having ordinary skill in the art would have to perform experimentation to create all of the possible products from the present invention, "an extended period of experimentation may not be undue if the skilled artisan is given sufficient direction or guidance." *See, In re Colianni*, 561 F.2d 220, 224, 195 U.S.P.Q. 150, 153 (CCPA 1977); *see also*, *MPEP* § 2164.06. "'The test is not merely quantitative, since a considerable amount of experimentation is permissible, if it is merely routine, or if the specification in question provides a reasonable amount of guidance with respect to the direction in which the experimentation should proceed.'" *In re Wands*, 858 F.2d 731, 737, 8 U.S.P.Q.2d 1400, 1404 (Fed. Cir. 1988)(*citing, In re Angstadt*, 537 F.2d 489, 502-04, 190 U.S.P.Q. 214, 217-19 (CCPA 1976)).

In this case, sufficient direction and guidance are provided by the Specification. Additional process parameters are disclosed, further enabling claims 1 through 47. The Specification provides a detailed description of the use of a CVD system to carry out the process and methods of the present invention. *See, Specification*, col. 3, lines 4-62. The desired reactant gas (WF_6), inert carrier gases (e.g. Ar, N_2, He), and silicon source gases which include silane (SiH_4) and dichlorosilane (SiH_2Cl_2) are each described in the Specification. The Specification

also defines additional process parameters including the necessary flow rates of the gases and the desired temperature ranges:

> The flow rate of the carrier gases (Ar, N_2, He) may be as great as five to ten times the flow rate of the silicon source gas (either silane or dichlorosilane). The flow rate of the silicon source gas (either silane or dichlorosilane) in turn may be about 50-100 times the flow rate of the reactant gas. *Specification*, col. 3, lines 39-44.

> A temperature of the silicon wafers 18 during both steps of the deposition process (i.e. nucleation and deposition) will be on the order of about 450°C. or less and may be in the range of 200°C. to 500°C. *Specification*, col. 4, lines 6-9.

Given these parameters, no experimentation is needed to practice the present invention. A person having ordinary skill in the art would be able to perform the present invention by charging a CVD system with the necessary gases, setting the temperature within the ranges given, and following the operation description detailed in the Specification.

For example, one of ordinary skill in the art could easily form a tungsten silicide film using one of the processes claimed in the present invention from the information disclosed in the Specification. Claim 1 enumerates:

> A process for depositing a tungsten silicide film on a substrate comprising: depositing a nucleation layer of tungsten silicide on the substrate using a (CVD) process with a silane (SiH_4) silicon source gas and a reactant gas; and depositing a film of tungsten silicide on the nucleation layer using a (CVD) process by switching to dichlorosilane (SiH_2Cl_2) as a silicon source gas such that the dichlorosilane gas reacts with the reactant gas to form the tungsten silicide film at a temperature of less than about 500°C.

Using the process of claim 1 and the disclosure in the Specification, one of ordinary skill in the art knows that the formation of the nucleation layer of tungsten silicide is accomplished with a CVD process using silane as the silicon source gas and having a flow rate at about 50-100 times the flow rate of the reactant gas. A film of tungsten silicide is deposited on the nucleation layer using a CVD process by switching to dichlorosilane as the silicon source gas, wherein the flow rate of the dichlorosilane is about 50-100 times the flow rate of the reactant gas and the temperature is less than 500°C. Following this process results in the deposition of a tungsten silicide film on a substrate - an intended result of practicing a method of the claimed invention.

The Specification clearly defines all of the parameters necessary for one skilled in the art to deposit tungsten silicide films on substrates according to the processes claimed in the present invention. No undue experimentation is required. Therefore, the processes claimed in the present invention are enabled.

Furthermore, as detailed in the response to the previous Official Action, the characterization of tungsten silicide as WSi_x was well-known in the prior art. One having ordinary skill in the art would understand that WSi_x covered those compositions of tungsten silicide which could be formed in CVD systems using the processes defined by the Specification. Therefore, one of ordinary skill in the art understands that the process claims of the present invention cover the process of forming one of many forms of tungsten silicide using the parameters claimed and defined in the Specification.

Claims 1 through 47 encompass a process of depositing a tungsten silicide film on a substrate. The process is enabled by the Specification and no undue experimentation is necessary to practice any of the claimed processes. The parameters for the claimed processes are well defined in the claims themselves, or within the Specification. Because one of ordinary skill in the art would not have to perform any experimentation to carry out the claimed processes, the enablement rejection under 35 U.S.C. § 112, first paragraph, should be withdrawn and claims 1 through 47 allowed for issue.

35 U.S.C. § 103(a) Obviousness Rejections

Obviousness Rejection Based on Japanese Patent No. JP-39528 (English translation) to Kawanishi et al. Taken With U.S. Patent No. 4,632,057 to Price et al.

Claims 1, 2, 4, 5, 8, 9, 12-19 and 21 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Kawanishi et al.(Japanese Patent No. JP-39528) taken with Price et al. (U.S. Patent No. 4,632,057). Applicant respectfully traverses this rejection, as hereinafter set forth.

Kawanishi specifically teaches a two-step tungsten silicide deposition process. A first tungsten silicide film is formed on a substrate in the presence of silane (SiH_4) and tungsten

hexaflouride (WF_6) at a temperature of 360°C. The substrate is then transferred to a second reaction chamber wherein a second tungsten silicide deposition is carried out in the presence of dichlorosilane (SiH_2Cl_2) and tungsten hexaflouride (WF_6) at a temperature of 680°C. *See, Kawanishi* at 6. Kawanishi makes it clear that the first deposition is a low temperature deposition and the second deposition is a high temperature deposition. Kawanishi also notes that a low temperature deposition followed by a high temperature deposition is preferred because low temperature depositions alone are disadvantageous. *See, Kawanishi* at 4.

Price et al. teach a one-step tungsten silicide deposition process initiated by a plasma discharge within a deposition chamber. The single-step deposition process occurs in the presence of dichlorosilane (SiH_2Cl_2) and tungsten hexaflouride (WF_6) at a temperature of 450°C after deposition initiation is triggered by plasma discharge. *See, Price et al.* at col. 9, lines 1-12. Price et al. clearly teach that the plasma discharge is necessary to initiate or nucleate the low temperature deposition. *See, Price et al.* at col. 5, lines 60-63.

M.P.E.P. 706.02(j) sets forth the standard for a Section 103(a) rejection:

> To establish a *prima facie* case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or combine reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art reference (or references when combined) must teach or suggest all the claim limitations. The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, and not based on applicant's disclosure. *In re Vaeck*, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991). (Emphasis added).

The 35 U.S.C. § 103(a) obviousness rejections of claims 1, 2, 4, 5, 8, 9, 12 through 19, and 21 are improper because Kawanishi and Price et al., either individually or collectively, fail to support a *prima facie* case of obviousness. Applicant's arguments from previous responses to Official Actions responses are hereby incorporated by reference.

The Official Action provides two reasons for the obviousness rejection of claims 1, 2, 4, 5, 8, 9, 12 through 19, and 21. First, it is re-alleged that:

> one skill in the art [sic] would find it obvious to deposit the WSi_2 film of Kawanishi at the temperature range suggested by Price because lower temperature deposition would be beneficial in that thermal budget is reduced while assuring substantially the same deposition characteristics (e.g. temperature/deposition rate independency, film thickness uniformity) as the film is deposited at 680°C. *Official Action* at 5.

This allegation is in direct contrast with the teachings of Kawanishi. Although it may be intuitive that the thermal budget is reduced with a lower temperature deposition, it is not intuitive, or taught, that "substantially the same deposition characteristics" will be produced with a combination of Kawanishi and Price et al. In fact, as the Applicant has previously pointed out, Kawanishi teaches just the opposite. Kawanishi specifically states that "the WSi_2 film formed by such a low-temperature treatment had a poor adhesion with the substrate and a poor step coverage." *See, Kawanishi* at 4. More importantly, Kawanishi indicates that the low temperature tungsten silicide film and the high temperature tungsten silicide film deposited by the Kawanishi two-step method have different film qualities, thus, the deposition characteristics could not "substantially the same" if a low-temperature second step deposition was used with Kawanishi as propounded by the current rejection. *See, Kawanishi* at 10. Thus, the teachings of Kawanishi are in direct opposition to the motivation alleged in the Official Action for combining the references, precluding a finding of a *prima facie* case of obviousness.

Furthermore, Price et al. do not suggest that the incorporation of a low-temperature, plasma initiated deposition into a two-step deposition process is desirable. Price et al. provide no suggestion that "substantially the same deposition characteristics" as a two-step, low/high temperature deposition would be achieved with a two-step, low temperature plasma initiated deposition. Because neither Kawanishi not Price et al. provide the motivation alleged in the Official Action, a *prima facie* case of obviousness is precluded.

The second alleged reason for the obviousness rejection is that "once a nucleation layer has been formed, a WSi_2 film can be deposited at a temperature range of 390-400°C as suggested by Price because the application of an old process to make the same would have been within the level of an artisan." The basis for this allegation is that Price et al. teach a low-temperature deposition of tungsten disilicide outside of the presence of a plasma discharge. This is not true.

Price et al. make it painfully clear that the low-temperature deposition taught by Price et al. must be initiated by a plasma discharge. Specifically, "it has been found that the plasma discharge appears necessary to initiate/nucleate deposition" of the tungsten disilicide. *See, Price et al.* at col. 5, lines 60-62. Furthermore, Price et al. do not suggest that their process is to be used to deposit a tungsten disilicide layer over a nucleation layer created in a separate process. Instead, Price et al. teach the deposition of a tungsten disilicide film in a one-step process. Therefore, the lack of motivation to combine Kawanishi and Price et al. precludes a finding of a *prima facie* case of obviousness and the rejection of claims 1, 2, 4, 5, 8, 9, 12 through 19, and 21.

A *prima facie* case of obviousness is also lacking because Kawanishi and Price et al. fail to teach all of the limitations of the claims of the present invention. Specifically, Kawanishi fails to teach a two-step deposition of tungsten silicide performed at a temperature of less than about 500°C as recited in claims 1, 2, 5, 8, 9, and 13-17. Likewise, Kawanishi fails to teach a two-step deposition of tungsten silicide performed at a temperature of less than about 400°C as in claims 4 and 21. Furthermore, Kawanishi fails to teach a two-step deposition process wherein both steps are effected at a substantially equivalent temperature as recited in claims 16-19 and 21. The failure of Kawanishi to teach the deposition temperature limitations of the present invention, combined with the absence of any motivation to combine Kawanishi with Price et al., precludes a *prima facie* case of obviousness.

Price et al. also fails to teach all of the limitations of the claims of the present invention. Price et al. specifically describe a single step deposition at a temperature around 400°C wherein the deposition itself is initiated by plasma discharge. The Price et al. deposition is also carried out using a single silicon source gas, rather than two separate silicon source gases as in the two-step process of the present invention. The lack of a teaching of a two-step deposition process, the failure of Price et al. to teach deposition at a temperature in the range of 390-400°C using two separate silicon source gases, and the lack of motivation to combine Price et al. with Kawanishi, precludes a *prima facie* case of obviousness based on Price et al.

Furthermore, claims 18, 19, and 21 recite the claim language "said switching said silane

silicon source gas to said dicholorosilane silicon source gas occurring without interrupting said (CVD) process." Kawanishi specifically describes a two-step deposition process wherein the substrate upon which the deposition is occurring is removed from the reaction chamber following the low temperature deposition so that the process conditions may be changed before reinserting the substrate into the same, or a different, reaction chamber for the high temperature deposition step. Thus, Kiwanishi fails to describe a two-step deposition process wherein the CVD process is uninterrupted. Price et al. also fails to describe a two-step deposition process occurring without interruption of the CVD process. Failing to describe an uninterrupted CVD process, Kawanishi and Price et al. do not make obvious claim 18, nor claims 19 and 21 which depend therefrom.

With respect to claims 16 and 17, the Official Action indicates that the combined rejection meets the claimed limitations in that the 360°C low-temperature nucleation of Kawanishi is substantially equivalent to the 390°C deposition of Price et al. Applicant disagrees with the conclusion that the two temperatures are substantially equivalent. However, as stated herein, there is no motivation to combine Kawanishi with Price et al., therefore, a *prima facie* case of obviousness is not supported and claims 16 and 17 are allowable.

Additionally, claims 2, 4, 5, 9,12-17, 19, and 21 are allowable because they depend from a non-obvious independent claim. *See, In re Fine*, 837 F.2d 1071, 5 USPQ2d 1596, 1600 (Fed. Cir. 1988)(dependent claims are nonobvious under section 103 if the independent claims from which they depend are nonobvious).

For the foregoing reasons, claims 1, 2, 4, 5, 8, 9, 12-19, and 21 should be allowed over the 35 U.S.C. § 103(a) rejection based upon the unmotivated combination of Kawanishi and Price et al.

Obviousness Rejection Based on Japanese Patent No. JP-39528 (English translation) to Kawanishi et al. Taken With U.S. Patent No. 4,632,057 to Price et al., and Further in View of U.S. Patent No. 4,565,157 to Brors et al.

Claims 3, 6, 7, 10, 11, 20, 22 and 23 stand rejected under 35 U.S.C. § 103(a) as being

unpatentable over Japanese Patent No. JP-39528 (English translation) to Kawanishi et al. taken with Price et al. (U.S. Patent No. 4,632,057) as applied to claims 1, 2, 4, 5, 8, 9, 12-19 and 21 above, and further in view of Brors et al. (U.S. Patent No. 4,565,157). Applicant respectfully traverses this rejection, as hereinafter set forth.

Claims 3, 6, 7, 10, 11, 20, 22, and 23 each depend from independent claims 1, 8, or 18. As dependent claims, claims 3, 6, 11, 20, 22, and 23 are not obvious if the independent claims from which they depend are nonobvious. *See*, *In re Fine*, 5 U.S.P.Q.2d 1596, 1600 (Fed. Cir. 1988); *see also*, MPEP § 2143.03. As explained *supra*, independent claims 1, 8, and 18 are nonobvious, therefore claims 3, 6, 7, 10, 11, 20, 22, and 23 are nonobvious.

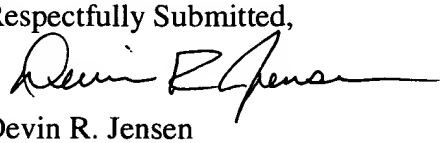
Furthermore, the combination of Brors with Kawanishi and Price et al. fails to establish a prima facie case of obviousness of claims 3, 6, 7, 10, 11, 20, 22, and 23. There is no motivation to combine the cold wall CVD reactor of Brors with Kawanishi or Price et al. to achieve deposition of tungsten silicide as taught in the present invention. The lack of motivation to combine Brors with Kawanishi and Price et al. precludes a prima facie case of obviousness. Therefore, claims 3, 6, 7, 10, 11, 20, 22, and 23 are nonobvious and allowable over the combination of Brors with Kawanishi and Price et al.

Claims 20, 22, and 23 are also allowable over the rejection as dependent claims because there is no motivation or suggestion to combine Kawanishi, Price et al. and Brors et al. to produce a process as claimed in claim 18. Specifically, none of the references suggest the uninterrupted CVD process claimed in claim 18.

CONCLUSION

Claims 1 through 47 are believed to be in condition for allowance, and an early notice thereof is respectfully solicited. Should the Examiner determine that additional issues remain which might be resolved by a telephone conference, he is respectfully invited to contact Applicant's undersigned attorney.

Respectfully Submitted,



Devin R. Jensen
Registration Number 44,805
Attorney for Applicant
TRASK BRITT
P.O. Box 2550
Salt Lake City, Utah 84110
Telephone: (801) 532-1922

Date: February 20, 2001

DRJ\csk:jb

N:\2269\3369.1\Amendment After Final - 20Feb01.wpd